

CLAIM AMENDMENTS

1. (Currently Amended) A semiconductor optical device comprising:  
a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and  
a reflecting multi-layer film ~~formed~~ including a plurality of layers and disposed on at least one of a pair of opposing end faces of the waveguide layer, wherein  
a summation  $\Sigma n_i d_i$  of products  $n_i d_i$  of refractive ~~index~~ indexes  $n_i$  and ~~film thickness~~ thicknesses  $d_i$  ~~for each of a layer denoted with i-th i~~ for each of a layer denoted with i in layers of the reflecting multi-layer film, and a wavelength  $\lambda_0$  of light guided through the waveguide layer satisfies a ~~relationship~~ relationship:

$$\Sigma n_i d_i > \lambda_0 / 4, \text{ and}$$

~~wherein~~ a first wavelength bandwidth  $\Delta\lambda$  is wider than a second wavelength bandwidth  $\Delta\Lambda$ , the first wavelength bandwidth  $\Delta\lambda$  being a wavelength range including the wavelength  $\lambda_0$  in which a reflectance R of the reflecting multi-layer film is not higher than +2.0% ~~from~~ of reflectance R at the wavelength  $\lambda_0$ , the second wavelength bandwidth  $\Delta\Lambda$  being a wavelength range including the wavelength  $\lambda_0$  in which a reflectance R' of a hypothetical layer is not higher than +2.0% from reflectance R' at the wavelength  $\lambda_0$  of a hypothetical layer having a thickness ~~of~~  $5\lambda_0 / (4n_f)$  ~~of~~ of a refractive index  $n_f$  ~~formed, disposed on~~ formed, disposed on the at least one of opposing end faces ~~satisfies a relationship~~ satisfies a relationship, and satisfying

$$R' = ((n_c - n_f)^2 / (n_c + n_f)^2)^2,$$

~~wherein the~~ where  $n_c$  denotes an effective refractive index of the waveguide layer.

2. (Currently Amended) A semiconductor optical device comprising:  
a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and  
a reflecting multi-layer film ~~formed~~ including a plurality of layers and disposed on at least one of a pair of opposing end faces of the waveguide layer, wherein  
a summation  $\Sigma n_i d_i$  of products  $n_i d_i$  of refractive ~~index~~ indexes  $n_i$  and ~~film thickness~~ thicknesses  $d_i$  ~~for each of a layer denoted with i in~~ for each of a layer denoted with i in layers of the reflecting multi-layer film, and a wavelength  $\lambda_0$  of light guided through the waveguide layer satisfies a ~~relationship~~ relationship:

$$\Sigma n_i d_i > \lambda_0 / 4,$$

~~wherein a ratio~~  $\Delta\lambda / \lambda_0$  is not lower than 0.062, ~~the~~ and  
reflectance R in the bandwidth  $\Delta\lambda$  ranges from -1.0% to +2.0% ~~of the~~  
reflectance R at the wavelength  $\lambda_0$ .

3. (Currently Amended) A semiconductor optical device comprising:  
a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and  
a reflecting multi-layer film ~~formed~~ including a plurality of layers and disposed on at least one of a pair of opposing end faces of the waveguide layer, wherein  
a summation  $\sum n_i d_i$  of products  $n_i d_i$  of refractive ~~index~~ indexes  $n_i$  and ~~film thickness~~ thicknesses  $d_i$  of ~~a layer each of denoted with i in layers of~~ the reflecting multi-layer film, and  
a wavelength  $\lambda_0$  of light guided through the waveguide layer satisfies ~~a relationship:~~  
$$\sum n_i d_i > \lambda_0/4,$$
 and  
~~wherein a ratio  $\Delta\lambda/\lambda_0$  is not lower than 0.066, the and~~  
reflectance  $R$  in the bandwidth  $\Delta\lambda$  ranges from -1.5% to +1.0% of the reflectance  $R$  at the wavelength  $\lambda_0$ .

4. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes a first ~~film~~ layer having a refractive index larger than a square root of an effective refractive index  $n_c$  of the waveguide layer and a second ~~film~~ layer having a refractive index smaller than the square root of the effective refractive index  $n_c$ .

5. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 4, wherein the first ~~reflecting-film~~ layer and the second ~~reflecting-film~~ layer are layered alternately.

6. (Currently Amended) ~~A~~ semiconductor optical device according to claim 1, wherein a first-layer ~~film~~ of the reflecting multi-layer film, which is in contact with the waveguide layer, has a refractive index smaller than a square root of an effective refractive index  $n_c$  of the waveguide layer.

7. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes at least three layers made of ~~material~~ materials different from each other.

8. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes seven ~~films~~ layers.

9. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes six ~~films~~ layers.

10. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes nine ~~films~~ layers.

11. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer film of the reflecting multi-layer film, in contact with the waveguide layer, has ~~the highest~~ a heat conductivity in the films in higher than other layers of the reflecting multi-layer film.

12. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer ~~film~~ of the reflecting multi-layer film ~~is~~, in contact with the waveguide layer ~~made of,~~ is aluminum nitride.

13. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein ~~a minimal~~ minimum value of the reflectance of the reflecting multi-layer film is within range from 1% to 32%.

14. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer ~~film~~, which is in contact with the waveguide layer, and a second-layer ~~film~~ of the reflecting multi-layer film have a refractive index smaller than a square root of an effective refractive index  $n_c$  of the waveguide layer.

15. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes eight ~~films~~ layers.